THE Pathway to perfect Sayling.

Being a deliuerie in as breefe manner as may bee, of the sixe principall pointes or groundes, concerning Nauigation: Writ-ten by *M*[r]. Richard Polter, *one of the late principall Maisters of the Nauie Royall.*

And now published for the common good of all Maisters, Pilots, and other Seamen whatsoeuer.

LONDON

Printed by Edward Allde for Iohn Tappe, and are to be solde at his Shop on Tower-Hill neere the Bul-warke Gate. 1605.

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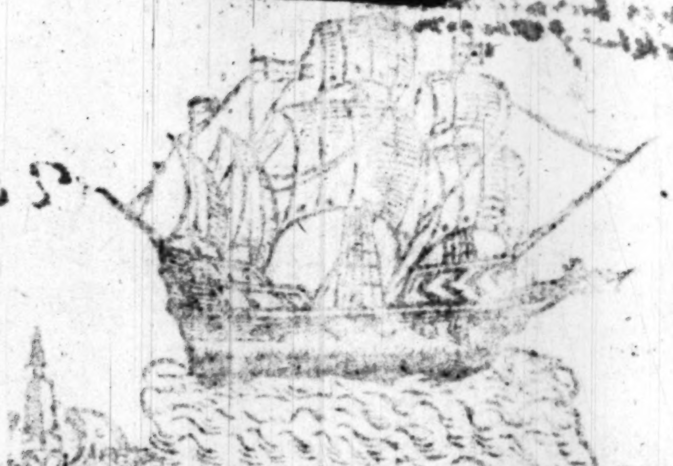
Being a delineatie in as briefe a manner as may bee, of the sixe principall pointes or groundes, concerning Navigation: Written by M. Richard Polter [illegible]

And now published for the commodge of all Mariners [illegible]



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THE
Path-way to perfect
Sayling.

A Deliuerie (in as briefe manner as may be) of the 6. principal poynts or grounds, concerning Nauigation: by Richard Polter, one of the principall Masters of her late Maiesties Nauye, as followeth.

Carde, Compasse, Tide, Time, Winde, Waye.	The 6. principall poyntes in Nauigation.

To deliuer the opinions (concerning the Carde and Compasse) of a great sorte of Sea Masters and others, euen in these times such is their knowledge, being altogether ignorant, euen vayne and friuolous, that I will not spend the time, once in nominating any such their knowledge, but will proceede to the matter.

The Compasse to be rectified two wayes.

First, there is to be deliuered two wayes for a mans farther knowledge, that the Compasse is to be rectified: as followeth.

The Compasse is said to be rectified when the wyer set right vnder the Flower deluce, the Flower deluce and his opposite poynt deliuereth the true Meridian.

Also the Compasse is said to be rectified, when the wyer set right vnder the Flower delice, the Flower delice and his oppolite poynte, delinereth the true mutation or variation of the Compasse.

Further, there are foure opinions concerning the Compasse: which foure opinions and wayes conceiued of the Compasse, being rectified to the true Meridian that it is presupposed to lead in, which I will giue a taste of for this present, and so leaue them to more conuenient places.

The 1. opinion of the Compasse.

The most absurdest way of the Compasse, is according to flatte Cardes vsed in Nauigation: which some sorte of men (and the greatest number) holde opinion, that the Compasse leadeth no otherwise then according to these vsuall Plats or Cardes right lyned, whose lynes generally are paralell each to other, and that the East and West of the Compasse leadeth in a paralell, which opinion is absurd: for how can the thing that is false deliuer the way of truth? as hereafter shall appere.

The 2. opinion of the Compasse.

This way of the Compasse (in deede) which is more perfect then the former (according to the iudgement of Astronomers) is called the Astronomicall deducture of the Compasse, and by other sorte of men called the paradorall Compasse, because the lineaments are spirall: which spiral lynes by some are called helicall lynes. This Astronomicall deducture (as aboue said) some sorte of me holde to be the principallest. In this iudgement the Meridians haue their coartation, but the Compasse (the East and West thereof) is said to lead in a paralell, therefore though nearer the truth then the former, yet absurde.

The 3. opinion of the Compasse,

Is the demonstrature of the Compasse, which is more excellent

excellent then the two former, being knowne aright: which demonstrature of ỹ Compasse, some sorte of men seeth (but with heads filled with infirmities &c.) e wãting knowledge, knoweth not the meaning thereof, and but very fewe vnderstand the goodnes that is to be deliuered thereby, yet the way of a Ship is not according to the present view thereof.

The 4. opinion of the Compasse.

Last of all (which fewest or none knowe) is the onely true and excellent way, the way of the Compasse according to the difference, neuer yet deliuered by any, nor knowne vnto those that make themselues most artificiallest.

I am now to deliuer my reasons or examples concerning these foure opinions (aboue said) which are to condemne the final knowledge, opinion or iudgement of men, concerning them: and to iustifie & maintaine the good knowledge that hereafter shall be deliuered.

The Carde & Compasse handled together.

WHereas, before I haue deliuered a taste of the foure opinions concerning the Compasse, the first opiniõ relying onely vpon the truth of the Carde, Therefore it is most necessary for me, next of all to deliuer the absurdities of the Carde, or to lay the Carde open in his colours, that when the truth thereof is seene and knowne, then that the way of the Compasse (according to the Carde vsed in nauigation) may bee left, & a more true way taken holde of &c. Now to proceed as followeth:

The 1. absurditie.

A generall Carde straight or right lyned, as it is, representeth, yea deliuereth the whole vniuersall world at the viewe thereof, as a playne flat or leuell and not otherwise, and maintayneth a scale correspondent thereunto, and how absurd this delinery is, hereafter is proued.

The 2. absurditie.

This generall Carde maintayneth a Compasse in the midst that shall extend it selfe, the poyntes thereof to the extreames of the Card, also deliuereth courses by one compas, to sayle to the extreames of the worlde, deliuered thereby if it were navigable, euen to any part thereof, and to returne the same way againe: which is absurde, as by the demonstrature and way of the difference following is proued.

The 3. absurditie.

This Carde will direct by halfe a Compasse made on the side of the carde, ouer the whole worlde, and the returne to be the same way, which is more absurde.

The 4. absurditie.

Yet this Carde will direct farther, that is by a quarter of the Compasse made in one of the corners of the Carde ouer the whole worlde, which will be made most absurd and monstrous by the grounds before spoken of.

The 5. absurditie.

This Carde also maintayneth from ỹ poles them selues an East and west lyne, a Meridian and seauen poyntes of either side, whereby the North pole deliuereth from it a South-east quarter and a South-west quarter, and the South pole the like, which is absurde: my reason to proue it to be so, is this, because there passeth no lynes imaginary from the poles, but only Meridians according to the sphere.

The 6. absurditie.

This Carde also maintayneth all the paralels of East and west therein, to be of one length, which is absurde: for paralels are lesse towards the poles: likewise the Carde iustifieth the paralels to make right angles with the Meridians euen to the poles, which is absurde, for paralels are inferiour

ferioure circles vnto the Meridians, which are great circles, therefore cannot make right angles with them.

The 7. absurditie.

This Carde also maintayneth all meridians to be paralels each to other, and thereby maketh a polar lyne of East and west in the pole it selfe as long as the equinoctial, which is an errour of 360. degrees, or 21600. myles, which is most absurde: my reason is this, because the pole it selfe is but an imaginary poynte.

The 8. absurditie.

Againe, there cannot be a right signe (for the way of a Ship) deliuered from the plaine of a Meridian in the Card, for the deliuery of the longitude, the meridians being paralels each to other (and wrested from their nature) as they be, neither can there be a second right signe (for the way of a Ship deliuered from the East and west of a Carde, for the deliuery of the latitude: because the paralels therein cannot deliuer neither the plaine of a great circle nor small: therefore the carde absurde.

The 9. absurditie.

Likewise, this presupposed way of the Compasse, according to the carde deliuereth vpon any poynt of the compas, for any segment in Nauigation, a lesse way in longitude and latitude then the Astronomicall deducture of the compasse, or way vpon the differences both, but if the longitude of this false way be compared and reckoned after the coasting of the meridians for any segment in latitude any longitude: then it is more swifter in longitude then any opinion els deliuered of the compasse: therefore absurde.

The 10. absurditie.

All the lynes in a Carde are supposed to bee segments, or peices of great circles, which is absurd and false: for example, great circles must double themselues at opposite

poyntes of neceſſitye, and therefore cannot be paralels each to other: likewiſe I am ſure they count thē not ſpirall lines, for ſpirall lines are not paralell either to other.

The 11. abſurditie.

The Equinoctiall and Meridian, in a Carde graduated, as they be by euen degrees both in longitude and latitude, being in plano not lawfully proiected, is abſurde.

The 12. abſurditye.

Likewiſe, the Card deliuereth this rule for his truth, vpon what poynte of the compas ſoeuer, the poynts being of one qualitie, in what latitude or longitude ſoeuer you are in, like diſtances for the differences of degrees in longitude: which is abſurde, and confuted by the Aſtronomical deducture, and by the way vpon the difference.

The 13. abſurditye.

Alſo the Carde deliuereth this for his truth, vpon what point of the compaſſe ſoeuer, the point being of one kinde, in what latitude or longitude ſoeuer: like diſtances for the raiſing or laying of a degree in latttitude, which is abſurd and falſe, as ſhall bee deliuered by examples vpon the difference.

The 14. abſurditie.

This Carde deliuereth no truth in Longitude: nor is neere the truth as is to be deliuered, therefore in places that are diſtant from other, the difference of time in no ſort is to be deliuered thereby, therefore more abſurde, then that which will deliuer the time more certaine.

The 15. abſurditie.

Whereas one Compaſſe (as before) in the mids of the Carde the pointes thereof being extended to the extremes thereof, and wideſt there, it is as contrarie to the truth, as

Falſhood

falshood is, for the poyntes of the Compasse, being extended in delatation but to the quadrant, which is 90. deg. according to the demonstrature in plano, not lawfully projected, is absurde.

But some of the poyntes to be extended (without) or beyond the quadrant 105. deg. to much, and continues in delatation, is absurd, but a halfe compasse in the East or west part of the Card, as the Card delivereth, some of which poyntes, from this halfe Compasse being extended beyond the quadrant, in delatation 276. deg. 45. min, to much, is more absurd. Nay a quarter of the Compasse delivered from one corner of the Card, as the card delivereth, some poyntes thereof are extended in delatation beyond the quadrant 300. deg. (of a great Circle) to much: which is most absurd, as the 15. parte in the Astronomicall deducture, and first part of of the demonstrature testifieth.

The 16. absurditye.

Whereas in this Card, the compasses in the midst, sides or corners thereof, extending their delatation & coarctation accordingly beyond the quadrant, as aforesaid, which is absurd: yet the delatation and coarctation within the quadrant, is also absurd: as for example, Prove from the center of any the compasses in the card, at 30. deg. delatation, and see whether the degrees there, be halfe so bigge as they are in the quadrant (as they should be) or no, and you shal finde 3. of the deg there, at 30. deg. delatation, to make but a degrée in the quadrant, which is ⅓ parte false: but it delivereth at 45. deg. delatatiõ 2. deg there, to be 1 deg. on the quadrant, which delatation, is 15. deg. false, or out of his due place.

The 17. absurditye.

It is a great matter, how absurde the Card is: for let a Ship in her navigation in any longitude or latitude whatsoever, sayle in the lyne of North-east or the like poyntes, as North-west and South-west, before she can accomplish one quadrant, she must use so much way in her navigation, as commeth to 127. deg. 15. min. of a great circle, which is 37. deg. 15. min to much, onely in that distance: but a quadrant according to the Sphere, is but 90. deg. of a great circle, which is the truth: therefore the Card [illegible].

The 18. absurditye.

A Ship in her navigation, differing in longitude according to the Card, altereth the pole from the [illegible] place, on the polar lyne to

the meridian, on the Card which the shippe is said to be in, which is absurde, as by the 18. part in the Sphere is iustified.

The 19. absurditye.

It is a merueile that the Card (being so monstrous) flowing with nothing but absurdityes, that one error thereof, being 21600 myles (as afore said) should be so greatly in request as it is, being no life or help in the worlde in it, to that which is good in nauigation: how it is possible for ẏ Cosmographie, Geographie or Geometrie thereof to be true: surely in this Card, the one is as true as the other and no truer, therfore all false and absurde.

So that the Compasse is wrested from the good nature it hath in it selfe for the deliuery of a right way, by the absurd opinion deliuered by, or receiued from the Card.

If I could alleadge more condemnations for the Card & the opinions of the compasse (being accordingly) yet enough suffiseth, vnlesse the matter in the Card (and knowledge thereby receiued) were better: And thus I leaue the Carde and the iudgement by it of the Compasse.

The Sphericall Descriptiō of the *Globe*, with the Astronomicall deducture of the Compasse accordingly, which by some sorte of men, is called the paradoxall Compasse.

Now will I proceed with the Astronomicall deducture of the Compasse: and because it dependeth vpon the lineaments of the Sphere, which is the ground thereof, as the Card is of the Compasse, vsed thereby in nauigation, therefore I will entreat somwhat concerning both the Sphere and deducture of the compasse vpon it: and as there are 19. absurdities before deliuered, for the confuting or deliuering the carde in his colours: so many partes I will touch, in this Astronomicall deducture, that the difference (betweene them) may be seene. But this in briefe by the way: The Astronomicall deducture cleareth a way from it many absurdities, by the coursing of the Meridians (onely) it maintayneth absurdly the East & West of the Compas, to leade in a paralell as hereafter shall appeare.

The 1. parte.

This whole description of the world, in Globe or round forme [illegible] lynes with meridians (one being graduated) likewise with paralels and [illegible] lynes, which by some men are called [illegible] by others called [illegible] lynes, & by some called [illegible] lynes, set downe with the Geographie, the scale thereof being the graduated meridian, which is correspondent thereunto, is very profitable to the knowledge thereof, and confuteth the [illegible] Carde.

The 2. 3. and 4. partes.

This Globe maintayneth a Compasse, being in the [illegible] of the earth and water, to extend it selfe according to the demonstrature in declination to the horizon and [illegible] deuiding it into 32. partes or poyntes correspondent [illegible] the way of a Ship out and home, to [illegible] according to this astronomicall opinion, that the East and west of the Compasse [illegible] a paralell, [illegible] which in this place and time cannot [illegible]

[illegible] imaginary [illegible] proceedeth onely meridians [illegible] true.

[illegible]

to be in their due forme, proportion, [illegible] the [illegible] and small [illegible] [illegible] paralels, [illegible]

[illegible]

and [illegible]

[illegible]

the place of a Shyps being, agreeth not, neither is true, as the difference iustifieth.

The 9. parte.

The way of the compasse, according to this astronomicall deliuery, for any sagments in nauigation [illegible] point [illegible], is more swifter in latitude, and more [illegible] in longitude, then the deliuery used in nauigation by the carde, deliuering the point of a shyps being, by the signes as aforsaid, which is absurde.

The 10. parte.

This opinion of the East and west, leading in a paralell, delinereth no sagments of any spirall lynes, to be sagments of great circles, which is absurde.

The 11. parte.

The Equinoctial & meridian in the Globe graduated as they bee, [illegible] degrees both in longitude and latitude, being in [illegible] Globe [illegible] true.

The 12. parte.

This opinion [illegible] any spirall lyne (of one [illegible]) which are the poyntes of the Compasse, according to this iudgement, not like distances for the difference of degrees in longitude, [illegible] betwene the [illegible] and the poles, [illegible]

The 13. parte.

And for this Astronomicall [illegible] any the spirall poyntes [illegible] in latitude: it [illegible] little from [illegible]

The 14. parte.

This Globe [illegible] eth it selfe into degrees of longitude, by which degrees, is deliuered the [illegible] of time [illegible] any two places or distances, yet not very true, as in the [illegible] of the [illegible].

The 15. parte.

As by this globe (being) [illegible] according to the demonstration [illegible] any one place [illegible] the horizon where it is [illegible] [illegible]

The

the carde, proued by this to be most absurde.

The 16. place.

By this Globe a compas in the zenith thereof, deliuering the azimuthes to the horizon which is at 90. degrees from the zenith, you shal finde these azimuthes at [illegible] dilatation, where 2. degrees maketh 1. degree in the horizon, and all the rest of the azimuthes or degrees of them, is deliuered with truth, either in delatation or courtation, therefore this 5. absurditye in the carde [illegible]

The 17. place.

[illegible] this globe deliuereth [illegible] grees [illegible] according to the 17. absurditie.

The 18. place.

This Globe [illegible] in their places, which is true.

The [illegible]

The Compasse [illegible]

[illegible]

[illegible] ner the horizon.

The.

Heere followeth the demonstrature of

In any latitude and longitude whatsoeuer, the [illegible] of the Compasse representing our earth, the zenith of the earth [illegible] so into 360. partes, nay rather into infinite partes [illegible] circles or azimuthes going [illegible] from the zenith or [illegible] and from this horizon or [illegible] parte of the [illegible] azimuthes or vertical [illegible] called [illegible] all which are [illegible] to the nadir, [illegible] are circles of depression, any one of [illegible] may be deliuered vpon any degree or minute of height aboue the horizon, likewise [illegible] in some working sphere) in profundities and depth vnder the horizon.

The 4. parte.

This demonstrature [illegible] any azimuth whatsoever, the distance from the zenith [illegible] to be but 90. degrees.

The 5. parte.

The East & west of this demonstrature (from the zenith) 90. degrees in longitude, toucheth the Equinoctiall, in the [illegible] opposite pointes.

The 6. parte.

Now the qualitie of the Globe is this, the pole thereof being eleuated, or set to the [illegible] latitude in his horizon, according to this demonstrature, [illegible] the obliquitie of the sphere, which in truth is a [illegible] of the East and west [illegible] paralell, as for example.

The 1. Example.

The Globe set to the paralel of 90. degrees north latitude, then a perpendiculer line [illegible] from the zenith of 90. degrees north latitude [illegible] south latitude, so that it [illegible] the opposite parte of the paralell, to be from the nadir as the arke of the meridian, contayneth, betweene the oposite parte of the the paralel and the nadir [illegible] a 100. degrees oblique, or different, and from the place of being in the zenith, upon the meridian, to the oposite part of the paralell directly, is but 80. degr. of a great circle, for that this oposite parte of the paralell is 10. degr. aboue the Horizon, which is oblique to the zenith and nadir, also 90. degrees north from the east and west of the demonstrature, in the equinoctial [illegible] lying in, (or [illegible]) [illegible] the perpendicular of the ship [illegible] in this zenith [illegible] and the oposite part of that paralel, is oblique [illegible] how is it possible for the east and west of the compas to leaue in a paralell?

The 2. Example.

Likewise when the ship, the right line [illegible] in the verticall circle of east and west [illegible] the ship on, toucheth the equinoctial opposite pointes, 90. degrees different in longitude, and the ship being a segment of that great circle, and no segment of a smal circle, as paralels are, how is it possible, then for the east and west to leaue in a paralell: it is not possible as the way of the difference [illegible].

The 3.

North-east in the latitude 51 degrees
30. minutes.

ward from the firſt, and there likewiſe toucheth the 26. degrees 15. min. paralel north: alſo it there toucheth the horizon 45. deg. either from the cardines Eaſt or north.

North-weſt.

Likewiſe, the demonſtrature of the north-weſt cutteth the meridians & paralels, in longitude weſt-wards, as the demonſtrature of north-eaſt cutteth them eaſt-wards, onely that it cutteth the horizon 45. degrées either from the cardines weſt or north.

South-eaſt in the ſame latitude 51. deg. 30. min.

In our place of being (as aforeſaid) I am to demonſtrate three ſegments of a great circle, containing 30. deg. a peece, by the demonſtrature ſouth-eaſt, the end of which firſt ſegment of 30. deg. ſhall touch the 23. deg. 30. min. of meridian in longitude eaſtward from the firſt, and there likewiſe toucheth the 27. degrées, 20. minutes paralel north.

And the end of the ſecond ſegment of 60. deg. in longitude, ſhall touch the 37. deg. 40 mi. of meridian in longitude Eaſt-ward from the firſt, and there likewiſe toucheth in 0 deg. 15. . north latitude.

Likewiſe, the end of the third ſegment at 90. deg. in longitude, ſhall touch the 51. degrée 40. min. of meridian, in longitude eaſtward from the firſt, and there likewiſe toucheth the 26. deg. 15. . paralell ſouth: Alſo there toucheth the horizon 45. degrées either from the cardines eaſt or ſouth.

South-weſt.

Likewiſe, the demonſtrature of the ſouth-weſt, toucheth the meridians and paralels in longitude weſt-ward, as the demonſtrature of ſouth-eaſt toucheth them eaſt-ward, onely that it cutteth the horizon 45. deg. either from the cardines ſouth or weſt.

Examples in the paralel of 80. deg. north latitude beginning with the firſt example of north-eaſt in the north latitude 8. deg.

From our poynt of being, in our meridian, which is the beginning of our longitude, our zenith being in the paralell of 80. degrées north latitude, I am to demonſtrate 3. ſegments of a great circle, containing 30. deg. apéce by the demonſtrature north-eaſt, the end of which firſt ſegment of 30. degrées, ſhall touch the meridian in longitude eaſt-ward 119. degrées 30. minutes from the firſt, and there likewiſe ſhall touch the paralell of north latitude 66. degrées.

And the end of the second segment at 60. deg. in longitude, shal touch the 42. deg. 30. min. of meridian in longitude east-ward from the first, & there likewise toucheth the 36. deg. 45 min. paralel north.

Likewise, the end of the 3. segment at 90. deg. in longitude shall touch the 45. deg. 30. min. of meridian in longitude east-ward from the first, & there likewise toucheth the 7. paralel north. Also there toucheth the horizon 45. deg. either from the cardines east or north.

North-west.

Likewise, the demonstrature of north-west cutteth the meridians and paralels in longitude west-ward, as the demonstrature of north-east, cutteth them east-ward onely, that it cutteth the horizon 45. deg. either from the cardines west or north.

Example of the South-east in the same latitude 60. deg.

In our place of being, (as aforesaid) I am to demonstrate the 3. segments of a great circle, containing 30. deg. apiece, by the demonstrature south-east, the end of which first segment of 30. deg. shal touch the 35. deg. 40. min. of meridian in longitude east-ward from the first, and there likewise toucheth the 32. degrees 10. min. paralel north.

And the end of the second segment of 60. deg. in longitude shall touch the 41. degrees 40. min. of meridian in longitude east-ward from the first, and there likewise toucheth the 22. degrees 40. min. paralel north.

Likewise, the end of the third segment at 90. deg. in longitude shal touch the 45. deg. 30. min. of meridian in longitude east ward from the first, and there likewise toucheth the 7. paralell south. Also there toucheth the horizon 45. deg. either from the cardines east or south.

South-west.

Likewise, the demonstrature of south-west, cutteth the meridians and paralels in longitude westward, as the demonstrature of the south-east cutteth them east-ward, onely that it cutteth the horizon 45. deg. either from the cardines south or west.

And as for the arkes of depression, from the horizon or semi or to the nadir of these pointes before spoken of, the delivery of them is euen as easie as the former, and so is any arke of altitude, or arke of depression vpon any azimuth whatsoeuer. Onely this

folowing

folowing to be respected as a preparatiue: before I deliuer any nice examples according to the difference, it is necessary for me to explaine in a more familiar sorte (at large) some parte of the difference only according to the demonstrature, for the more confuting of the Carde, and the opinion helden thereof for the way out and home to be all one. It is deliuered in the 15. absurdity of the Carde, that upon some poyntes of the Compasse, the Carde delivereth a way outward, to be 390. degrees of a great circle, and to returne homeward (to the first place) againe, the like distance upon the same lyne. which shal be proued most false by the examples folowing: which examples shall be from the latitude of 50. degrees and from the first example, as before in the latitude 51. degrees 30. minutes, yet these deliueries not the truth neither, as by examples upon the difference, hereafter folowe.

The 1. example in north latitude 50. deg.

In which latitude, our zenith or place of being in one meridian, where we make our beginning of longitude and place of departure, I am now to deliuer from this our zenith or place of being, the demonstrature north-west for one segment of 30. degrees in longitude: which segment and of 30. degrees north-west there cutteth the [illegible] degrees [illegible] minutes a meridian westward in longitude, and the 63. degree paralel north.

Our zenith now being altered, and the latitude 63. degrees as aforesaid, we will make proofe to returne backe againe to our first place by the south-east, the like segment of 30. degrees in longitude, where this segment encountreth the 26. degree 30. minutes or meridian in longitude eastward, and there likewise cutteth the 37. degrees 40. minutes paralel north.

So that this lyne of north-west, extended to 30. degrees as aforesaid, and from thence returning south-east to 30. degrees likewise, there is [illegible] in longitude [illegible] from the first meridian or place of departure [illegible] degrees [illegible] minutes or meridians and in latitude southwards from the first [illegible] deg. 30. minutes.

Heere you see the difference of the way out and home, onely for 30. degrees according to the demonstrature, [illegible] the [illegible], hath [illegible]

The

The 2. example in north latitude 51. deg. 30. min.

I am now to deliuer from this our zenith or place of being, the demonstrature of the northeast to 90. degr. which line of north-east, there cutteth the 128. degree or meridian in longitude eastward from the first, and there likewise cutteth the 26. degree 15. minutes paralel north, as in the demonstrature is deliuered.

Our zenith now being altered, and in the latitude 26. degrees 15. minutes as before said. We will make a proofe to returne back againe to the first place, by the demonstrature south-west to 90. degrees, where this line of south-west cutteth but the 65. degrees 30. minutes meridian in longitude westward, and there likewise cutteth the 39. degrees 30. minutes paralel south. So that this lyne of north-east, extended to 90. degrees as aforesaid, and from thence returning south-west to 90. degrees likewise, there is difference in longitude east-ward from the first, 62. degrees 30. minutes, and in latitude southward from the first 91. degrees.

Heere you see also the difference of the way out and home, onely for 90. degrees, according to the demonstrature, and onely for the lynes of north-east and south-west, and all the rest of the points is the like in their kinde. And so I leaue the demonstrature.

Now will I deliuer examples worthy the noting, of the way of the Compasse according to the difference.

The East or West of that Compasse, referred to the true meridian upon the difference, maketh a spirall lyne in declination to the equinoctial from what paralel soeuer, by segments of (great circles) correspondent for this purpose. which segments maketh right angles with the meridians, and which segment declineth a right ligne from the plaine of the vertical circle of east and west for the way of a Ship in her nauigation, and the meridian according to this difference deliuereth the other. This parte of the difference onely confuteth the generall Carde and the lynes of inclination, with the Geographye of the Globe.

This difference, the east and west thereof relating, as aforesaid, ruleth notwithstanding, the variation of the Compasse, generally spoken of, as for example: the Compasse here with us at London, is set at halfe a poynte variation eastward, where it

should

should be 10. degrees 38. minutes 45. seconds by my owne obseruations, which maketh the west to be halfe a poynt to the northward of the west: therefore in going from Sillye (which is in latitude 50. degrees 15. minutes or there abouts) west by the Compasse (which is in truth west halfe north) with Cape race, in newfound-land, the places distant some 600. leagues from other, causeth a falling more southerly into the latitude 46. degrees 30. minutes or thereabouts, which sheweth the way of the difference to rule in this distance.

And by a Compasse rectified to the true meridian, that is a Compasse that the north and south thereof, delivereth or pointeth according to that true meridian of Sillye, on which meridian is delivered the arke of altitude or almicanter of the Sunnes height at noone, by which or such Compasse, Cape race beareth from Sillye due west and by north, and there toucheth the paralel of north latitude 46. degrees 30. minutes, likewise toucheth the meridian in longitude westward from Sillye the 45. degrees 40. minutes according to the coarting of the meridians in this distance.

And to speake the truth, in this distance there is but little or no variation of the Compasse to be respected, for the Compasse at Sillye set at the whole variation as it ought to be, yet in sayling by that Compasse westward some 400. leagues before the north and south [illegible] thereof delivereth the true meridian: and in sayling the other 200. leagues, the compasse is varied westward a point and a halfe or thereabouts, which is no more than wil answer the variation eastward, as before is, so that in this distance, the variation of the compasse, east-ward, & west-ward, con[illegible] is as nothing to bee respected, (but the one set against the other,) as by the examples following is proued.

The first example.

Let a compas be rectified to the variation, and sayle from Sillye [illegible] to cape race, west: & when you come on the coast of new found land, you shall be delated from the paralell of Sillye [illegible] according to the difference, and not otherwise.

The second example.

Let the compas be set at halfe a point variation, as most commonly it is, and sayle by that Compasse from Sillye west with Cape race, and you shall perforce (keeping that course directly)

fall into a more southerly latitude, which is into 46. degrees 30. minutes or thereabouts, according to the difference, and not otherwise.

The third example.

Let the Compasse be [illegible] the true meridian, and saile by that Compasse from Sillye west with Capercace, and you shall likewise fall into the latitude [illegible] degrees or thereabouts, according to the difference.

And as in this way (abouesaid) is delivered a deviating from the paralel in going west: so likewise in returning east [illegible] thence againe, you shall likewise [illegible] that paralell againe, according to the difference: which [illegible] the whole Carde.

Againe, [illegible] the difference of the east and west [illegible] in the distance and difference in longitude (as afore is said) from any other distance and difference in longitude, it is likewise [illegible] points. Also [illegible] of the east and west, to the ground from whence the difference is [illegible], [illegible] all the rest of the poyntes of the Compasse.

So that you see, this way upon the difference, [illegible] distance to any place, [illegible] being not [illegible], as by the examples of the north-east [illegible] south-west likewise of the north-west [illegible] south-east, as hereafter appeareth.

The [illegible] parte of the 1. example from the equator.

Being in the Equinoctiall in any one meridian, [illegible] beginning of longitude [illegible] meridian of longitude, I [illegible] the line of [illegible] north-east, continuing it to the latitude [illegible] degrees 6. minutes [illegible] seconds, according to the difference.

The 2. parte of the 1. example.

The line of the north-east continued to the latitude [illegible] degrees 6. minutes 14. seconds, according to the difference, [illegible] in the longitude 1 [illegible] degrees from the first, reckoned according to the meridians in this distance [illegible].

The 3. parte of the 1. example.

Being in the latitude [illegible] degrees 6. minutes [illegible] seconds, and in the longitude [illegible] degrees as aforesaid, I [illegible]

backe

backe againe by the lyne of inclination, south-west to the Equinoctiall.

Conclusion of the 1. example.

Being returned to the Equinoctiall as afore-said, I doe finde the length of the lyne of inclination south-west homeward, to be shorter then the lyne of north-east outward, by 13. leagues, and I am in longitude eastward from the first place on the Equinoctiall 20. leagues, therefore the way out and home not all one.

Another example in the latitude of 50. degrees.

I sayle north-west 50. leagues, at the 50. leagues end I haue altered my longitude from the first, 2. degrees 5 8 minutes, and my latitude 1. degree 40. minutes.

I returne backe againe south-east 50. leagues, and being returned, I finde my selfe in lesse longitude or westward from the first, 3. minutes, and in latitude more then the first 6. minutes.

Another example in the north latitude of 60. degrees.

I sayle north-west 50. leagues, at this leagues end my longitude from the first is 3. degrees 20. minutes, and latitude from the first 1. degree 50. minutes. I returne backe againe south-east 50. leagues, and being return'd, I finde my selfe in lesse longitude or westward from the first, 5. minutes, and in latitude more then the first, 10. minutes.

And for the more confuting of the way out and home to be all one, and the more iustifying the dilating from the paralel to be true, I will deliuer some more examples vpon the east, for a sagment of 20. leagues, in the latitudes 51. degrees 30. minutes, and 75. degrees, deliuering the horizontall distance betweene the east (according as is said) to lead in a paralel, and the way of the east according to the difference, as followeth.

In latitude 51. deg. 30. minutes, my 1. place.

From any one meridian of longitude I take a sagment of the paralel in this latitude of 20. leagues, which proued by some to be east from the first place: and againe, I vnde the place from my first place of being 20. leagues eastward according to the difference I now at this 20. leagues end I am declared from the paralel, according to the way vpon the difference, which maketh my place (now of being) to beare from the first place 21. minutes, and ½ more southerly.

As for example.

To explaine it more briefly, I imagine one lyne from the first place east, according to the paralel 20. leagues: imagine an other lyne from the first place east by the Compasse, according to the way vpon the difference: now the horizontall diffance betweene these two lynes at 20. leagues end, from the first place, shalbe (as before) two azimuthes $\frac{1}{2}$.

In the latitude 75. my first place and meridian of longitude, I take a sagment of the paralel in this latitude, of 20. leagues, presupposed likewise by many to be east from the first place: and againe, I doe departe from my first place of being, 20. leagues east, according to the way vpon the difference: now at this twentie leagues end, my horizontall diffance betweene my place of being, and place (as afore said,) on the paralel, from the first place, is 3. azimuthes $\frac{1}{2}$.

Likewise this way of ỹ difference, delineateth vpon any azimuthe, or point of the compasse, sagements of great circles, different from other, correspondent as they ought to be, for the difference in longitude as hereafter by three examples of the north north-west following appeareth, which confuteth the 12. absurdities of the Carde.

Three examples of the North North west, for the difference of the length of Sagements in longitude from the equinoctiall to 80. degrees in latitude as followeth.

The 1. Example from the equator.

Being in the equinoctiall in one meridian, the sagement of north north-west to reach to the next Meridian (which is one degree in longitude, is in length 52. leagues $\frac{1}{2}$.

The 2. Example from 40. deg. of latitude.

Being in 40. degr. of latitude, and in one Meridian, the sagment of nearly north-west, to touch the next meridian is in length 37. leagues $\frac{3}{4}$.

The 3. example from 80. degrees of Latitude.

Being in 80. degrees of Latitude, & in one meridian, the sagment of northnorth-west to touch the next meridian, is in length 5. leagues $\frac{1}{2}$.

Also this way of the difference deliuereth vppon any azimuth or point of the compasse, sagments of great circles, different from other, for the laying or rayling of a degree in latitude whatsoeuer, as by 3. examples of the west north west following appeareth, which confuteth the 13. absurditie of the carde.

The 1. example from the equator.

I beeing in the equinoctiall, am required to deliuer a sagment of the west north west, onely to raise a degree in latitude, which according to the difference, is 12. leagues and $\frac{1}{2}$.

The 2. example from 40. deg. of latitude.

I beeing in 40. degrees of latitude, the sagment of [illegible] north-west to rayse a deg. in latitude vpon the difference is 56. leagues.

The 3. example from 80. deg. of latitude.

I being in 80. degrees of latitude the sagment of a west north-west, to raise a deg. in latitude vpon the difference is 60. leagues.

And thus will I leaue the way of the compas vpon the difference for this time.

And because the variation, or nutation concerneth the compasse, and is a thing deliuered in print, ment belike to some purpose: therefore I will touch this variation, or nutation, in some few words as hereafter followeth.

If a man for his deliuerie of the variation in print, should obserue by a needle touched by some, who waieth the common or ordinarie compasses, I take it, practise followes, would soone bee deliuering forth, that the variation so set in print, were wide from the truthe.

Because with some men, in the touching of a needle, or Compas, it thought the stone they touch withall, be not the best, neither shall an inch in breadth of the north parte of that stone, breake any square with them, by whose compasses many time shipping at the Seas be indangered:

It were better for a man for the securitie of his charge, or that purposed to set downe the variation in print, to take a needle touched by a better stone and a more perfect man to handle the touching therof truely when Robert Norman dyed (who had a good stone) Seamen had a great losse, yet Maister Mullineux of Lambeth, who hauing a better stone was as carefull as practise.

As for example.

To explaine it more breifly, I imagine one lyne from the first place east, according to the paralel 20. leagues: imagine an other lyne from the first place east by the Compasse, according to the way vpon the difference: now the horizontall distance betweene these two lynes at 20. leagues end, from the first place, shalbe (as before) two azimuthes $\frac{1}{10}$.

In the latitude 75. my first place and meridian of longitude, I take a sagment of the paralel in this latitude, of 20. leagues, presupposed likewise by many to be east from the first place: and againe, I doe departe from my first place of being, 20. leagues east, according to the way vpon the difference: now at this twētie leaghes end, my horizontall distance betweene my place of being, and place (as afore said,) on the paralel, from the first place, is 3. azimuthes $\frac{1}{10}$.

Likewise this way of $\frac{1}{10}$ difference, delineteth vpon any azimuthe, or point of the compasse, sagements of great circles, different from other, correspondent as they ought to bee, for the difference in longitude as heereafter by three examples of the north north-west following appeareth, which confuteth the 12. absurditie of the Carde.

Three examples of the North North west, for the difference of the length of Sagements in longitude from the equinoctiall to 80. degrees in latitude as followeth.

The 1. Example from the equator.

Being in the equinoctiall in one meridian, the sagement of north north-west to reach to the nert Meridian which is one degree in longitude, is in length 52. leagues $\frac{1}{10}$.

The 2. Example from 40. deg. of latitude.

Being in 40. degr. of latitude, and in one Meridian, the sagment of north north-west, to touch the nert meridian is in length 37. leagues $\frac{1}{10}$.

The 3. example from 80. degrees of Latitude.

Being in 80. degrees of Latitude, & in one meridian, the sagment of north north-west to touch the nert meridian, is in length 5. leagues $\frac{1}{10}$.

Also

Also this way of the difference deliuereth vppon any azimuth or point of the compasse, sagments of great circles, different from other, for the laying or rayling of a degree in latitude whatsoeuer, as by 3. examples of the west north west following appeareth, which confuteth the 13. absurditie of the carde.

The 1. example from the equator.

I beeing in the equinoctiall, am required to deliuer a sagment of the west north west, onely to raise a degree in latitude, which according to the difference, is 12. leagues and $\frac{1}{2}$.

The 2. example from 40. deg. of latitude.

I beeing in 40. degrees of latitude, the sagment of [illegible] north-west to rayse a deg. in latitude vpon the difference is 56. leagues.

The 3. example from 80. deg. of latitude.

I being in 80. degrees of latitude the sagment of a west north-west, to raise a deg. in latitude vpon the difference is 60. leagues.

And thus will I leaue the way of the compas vpon the difference for this time.

And because the variation, or nutation concerneth the compasse, and is a thing deliuered in print, ment belike to some purpose: therefore I wil touch this variation, or nutation, in some few words as hereafter followeth.

If a man for his delinerie of the variation in print, should obserue by a needle touched by some, who maketh the common or ordinarie compasses, I take it, prefice fellowes, would soone bee deliuering forth, that the variation so set in print, were wide from the truthe.

Because with some men, in the touching of a needle, or Compas, though the stone they touch withall, be not the best, neither shall an inch in bredth of the north parte of that stone, breake any square with them, by whose compasses manye time shipping at the Seas be indangered:

It were better for a man for the securitie of his charge, or that purposed to set downe the variation in print, to take a needle touched by a better stone and a more perfect man to handle the touching therof: truely when Robert Norman dyed (who had a good stone) Seamen had a great losse, yet Maister Mullinux of Lambeth, who hauing a better stone was as carefull as prefice.

in his busines, concerning the touching of needles, & compasses, as euer Maister Norman was.

Notwithstanding the variation (by such a good needle) set down in print and deliuered as a generall thing, would bee but iested at: & made a thing indeede ỹ a man might spend much time to no purpose and lesse edifiing to the Sea men, as some hath done: my reason is this, because this stone (though a notable one) and I haue not seene a better, & good to make obseruations withal to be kept to a mans selfe: or out of print, or for the amplifying of some note in writing, it cannot deliuer the variation of an other stone, for in truth the variations deliuered by many stones, are differe[illegible] you shall not haue two stones alike qualitide, or that will deliuer one and a like variation, but the variation of euerie stone differeth frō other: there cannot generally be set down a certaine variation for any one place, which let suffice for this time.

Therefore, that man that was is conceited to set the variation in print, as a general thing: though it were my selfe, all things to nothing, I would there in my deliuerie, likewise bee condemning al mens knowledge sauing my own, to iustifie my doings.

But to the matter, the variation or nutation of the compasse as it shal at any time or place be found, is a thing to be noted, yet my deliuerie is of it, ỹ it is not surpassing all other knowledge, neyther the ouerthrow of good knowledge, neither wil I accept of it as a thing notable aboue al the rest: my reason is this, because the way vpon the difference, being more excellent, ouer ruleth it, which indeede they impute to variation, which is vntrue: and thus will I leaue the nutation of the compasse.

And whereas before in my deliuerie of the nutation, I had forgotten to giue a taste of the error, which is likewise set in print, & conceaueth the nice deliuerie of the said nutation: I thought it nowe therefore good (though late) not to ouerpasse it but to giue knowledge thereof: it is said that the middle point betweene any two azimuthes obserued vpon equall elevations in forenoon and after noone, is the true Meridian.

For the confuting hereof I wil deliuer you an example in the north Latitude 51. degrees 32. minutes as followeth.

The Sun being in her swift declination, in or neere the equator, I purpose to make two obseruations: the former obseruation

to

to be 2. min. before 8. of the clocke in the forenoone, the Almicanter deliuered then by the center of the sun, being 18. deg. in eleuation, & the horizontall distance east ward from the true meridian deliuered by the Azimuth of the Sunne to be 66. degr. 38. min.

The second obseruation in the afternoone, the Sunne hauing the same Almicanter 18. degrees: the declination increasing respected, for 8. houres, which is 8. min. north declination, maketh the time to bee 3. min. after 4. a clocke in the after noone, wherein there is a min. of time difference from the south and the horizontall distance west ward from the south, to be 66. deg. 53. min. So that I finde this last obseruation to bee farther from the true Meridian, then the former, by 15. mi. but if the declination were decreasing, then ỳ last obseruation will be nearer the true meridian then the former by 15. minutes, which maketh a difference of variation, sometime to much, or some time to little, by 15 minut. good, which is an error; and therefore not the truth.

Concerning the Tides.

Euen as mens minds for the moste part are fettled in the abfurdities, of the carde and compaſſe accordingly, ſo are they ſettled likewiſe in an abſurde reckoning of their tides, as hereafter by the greate of God ſhall appeare, diuided into 2. parts, firſt by the deliuerie of the epact, next according to the time obſerued, by the point of the Compaſſe, as followeth.

The 1. parte.

Theſe men doe not onelye know ỳ prime by ỳ date of our Lord & the Epact, by the prime, & the day of coniunction by the epacte which is tollerable; according to the order of the epacte, allowing. 30 dales to euery Moone: or on the 30 day end, to be coniunction, which is notwithſtanding partlye at random, being without reſpect, of the preciſe time of the coniunction.

But they ſuppoſe alſo, the departure of Sunne and Moone in 24. houres to be continually 48. minu. as though the motions of the Sunne and Moone continued all one, or that 48. minu. were their meane departure.

For they bring the 32 pointes, euerye point being a 11. degr. and a ¼ a ſunder, the whole being 360. degr. to 30. whole dales, allowing to euerie 24. houres the departure to bee, (as ſaid is ſaid) 48 min.

48. min for 30. times 48. minutes is 24. houres: and 4. minuts of time is answerable to one degree of the equator; therefore the departure is 12. degrees is 24. houres allowing the iust revolution of the equator to bee in 24. houres, neither more nor lesse, for 30. times 12. degrees is 360. degrees, in which their reckoning in my conceite, the course of the Sun in those 30. daies, which is about 29. degrees 30. min. is forgotten or not respected, but eyther they must of necessitie graunt that the revolution of the equator, and the departure of the Sunne and Moone, to be as heereafter shall be delivered: or else they must allowe the moones error in her yeerely course, to be 5. daies, 15. houres 2. minut. to much, which is an absurditie, and maketh the sinodicall error more then it should bee, by 11. houres 25. minu. 56. sec. 40. thirds, but if they doe acckowledge, (which I take it, is in selve or none of their heapes) that the whole revolution of the equator, is turned, about in 24. houres, (as heereafter shall bee delivered) and so doe reckon the odde time, to bee for the meane course of the sunne in the 30. daies, yet they must acknowledge by that reckoning, that the coniunction of the Sunne and Moone, must happen almoste at like times of everie yeare, or at least wise, make the difference sooner of the yeerelie period of the coniunction, to bee, but 5. daies 6. houres 9. minutes, which indeede should bee 10. daies, 21. houres, 11. minutes, as heereafter shall bee delivered.

The 2. parte.

1 Also these men I iustifie in reckoning their tides, in what place & time soever: that where it floweth a south east moone in coniunction or opposition (& possible by a false Compasse) then it floweth till 9. a clocke: or where it floweth an east Moone in coniunction or opposition, then it floweth 6. a clock, & so its their iudgements, generally of all the rest of the pointes of the Compasse.

2 And to iustifie my sayings to bee true, they have set forth printed tide tables thereof, and in those tables also, have set their iudgements, that in coniunction or opposition it floweth 48. min. after the time vppon any point as aforesaide, which is absurde.

Therefore these their iudgements for the securitie of their charge, had as much neede of refining as the east and west of the Compasse said before, to leade in paralell.

Now to the matter, for the refining of the first parte as is forsaid,

said, let this first parte following suffice.

To knowe the times of the coniunction otherwise then by the Epact is delivered, by Ephimerides, or Alminacks, but rather knowne by that man that hath the knowledge himselfe in the Theorickes of the Sunne and Moone: which knowledge ought to be in a man that would be artificial to refine these absurdities.

In Meslines Astronomie, the motions of the Sunne & Moone are distinguished into three parts, slowe, swift and meane: that is to say: in Apogæum slowe, when they are farthest from the earth: in Perigeum swift when they are neerest the earth; and in their meane betweene the Apogæum and Perigeum, notwithstanding by these three motions, there is knowledge understood, that the motions of the Sunne and Moone are alwaies different, that is to say, the Sunne from his place in Apogeum, to his Perigæum: likewise the Moone from her apogeū & perigæum of her epicicle, & from her apogeum in her almost an oual forme of ỹ center of her Epicicle, to her perigæum therof being the like qualited.

To iustifie the Motions to be the truer: it is also delivered in this Astronomie, that the Sunne hath three Orbes or particuler Spheres as followeth.

First an excentricke, which is called the difference of the body of the Sun, secōd is called the difference of ỹ apogæum, of the excentrick: the which 2. doth containe the excentricke betweē the: & thirdly maketh the whole sphere of the Sun to be cōcentricke. I could delate more of this theorick the I purpose, but it would be to smal effect concerning the tides, onely this that followeth respected.

Three reasons to be delivered for this hypothesis aforesaid to be true.

1. First reason which causeth the Sunne to bee in an excentricke, is the difference of the Suns motion: which is proved sometimes to be, some times slowe, as aforesaid.

2. Second reason is, because the Diamiter of the Sunne, is proved sometime bigger (as in Perigeum 33. min. 44 sec. then at some other time by 2. minutes 6. seconds, therefore nearer at sometimes then at other times.

3. The third reason is the inequalitie of the Epicicles, because it is proved that the Sun farthest from the earth, causeth the eclipses to be longer, and neerer the earth, to be sooner.

Messine deliuereth also in his Astronomie that the greatest ercentricitie of the Sunne is 48. semidiameters of the earth.

And ♄ least ercentricitie which is neare in this our age about the 9. degree of Cancer, is 37. semidiameters of the earth.

So the difference is all 11. semidiameters of the earth, and the semidiameter of the earth is 3436. miles and ⅓.

So that the Sunne is nearer vnto vs at sometime, then at some other times by 74. semidiameters of the earth.

Messine deliuereth likewise, one yerely Periods of the Sunne to haue 365. daies 6. hour. 9. min. 39. sec. and this yeare he calleth Sideriall or starrie, the diurnall meane motion of the Sunne accordingly to be 59. min. 8. sec. 11. thirds. 22. fourths. 16. fifths.

The motions of the Sunne as followeth.

Her swift motion in. 24. hour is ——— 1. deg. 1. min. 16. second.
Her meane motion in. 24. hour is ——— 0. ——— 59. ——— 8.
Her slow motion in. 24. hour is ——— 0. ——— 57. ——— 0.

Messine deliuereth likewise, in his Astronomie, that the moone hath 5. Orbes or particular Spheares as followeth.

1. First, an ercentricitie.
2. Second, the difference of the epicicles center.
3. Third, the difference of the ercentricitie in Apogeum and perigeum.
4. Fourth, is the epicicle which carieth the bodie of Luna.
5. Fifte, which is concentricke called Deferens Lunæ.

Foure reasons following to proue this Hipothesis to be true.

1. First reason which causeth the Moone to be in an ercentrick is the difference of the Moones motion which is proued sometime swift, sometime slowe.

2. Second reason, is because the Diameter of the Moone is proued sometime bigger, as in Perigeum 33. min. 28. sec. then at some other time by 5. minut. 38. sec. therefore she is at sometimes then at other times.

3. Thirdly the inequalitie of the eclipses, because the moone farthest from the earth, causeth the Eclipses to be longer, and nearer the earth, to be sooner.

4. Fourthlie the inequalitie of the paralax, because the Moone

farthest

farthest from the earth, causeth the Horizontall paraler, to bee the lesse, and nearer to be more.

And the greatest excentricitie of the Moone is 10. semidiamiters of the earth, and $\frac{1}{10}$. a little lesse.

And the semidiamiter of the Epicicle is 5. semidiamiters of the earth and $\frac{1}{10}$. So that the Moone is nearer vnto vs, at sometime, then at some other times by 30. semidiamiters of the earth, and $\frac{17}{100}$. and likewise by the whole diamiter of the circulus paruus: which is 20. semidiamiters and $\frac{17}{100}$.

For the Moone maketh a circulus paruus, (contrarie to her owne motion) about the center of the worlde, according to the semidiamiter of the excentricke, which is 10. semidiamiters and 8. min. 30. seconds.

Likewise the Moone hath latitude of the ecliptick, on eyther side 5. degrees, which for the tides is greately to be respected.

Messine deliuereth one meane periodicall period of the Moone to haue 27. daies, 7 houres 24 minutes.

Also deliuereth the meane time to make vp the periodicall period to a meane sinodicall period to haue daies, 2. daies, 5. houres, 20. minutes.

So that the meane sinodiall month of the Moone to bee in conjunction, againe with the sunne hath daies. 29. daies. 12. houres 44. minutes. 3. sec. 11. thirds.

The motions of the Moone as followeth.

The swift Motion of the Moone, sometimes in 24. houres is 15 degrees. 0. min.

The meane motion in 24. houres is 13. degrees 30. minutes.

And her slow motion in 24. houres is 12. degrees 0. minutes.

Now hauing delinered so much as needeth of the Theorickes of the Sunne and Moone concerning the tides, we are come to the point to knowe their departure, which is as followeth.

The departure of the Sunne and Moone.

The Moone presentlie after the coniunction departeth eastward from the Sunne in Apogeum in 24. houres 12 deg. 3, min which is answerable in min to 44. min 12. seconds.

The Moone presently after the coniunction, departeth from the Sunne in Perigeum in 24. houres 13, degrees 58. minutes 44. seconds answerable in minutes, to 55. min. 55. seconds.

The Moone presently after the conjunction departeth frō the Sunne in meane motion, in 24. houres, 12. degrees. 30. min. 52. seconds, answerable in min. to 50. min 3. sec. ½.

Sometime the departure of the Sunne and Moone, when the Sunne is in her slowe motion, and the Moone in her swift motion, in 24. houres, is 14. degrees, 3. minu. which maketh the departure in minutes answerable to be 56. min. 12. seconds.

And sometime the departure of the Sunne and Moone, when the Sunne is in his swift motion, and the moone in her slow motion, in 24. houres, is but 10. degrees. 58. min. 44. seconds, which maketh the departure in min answerable to be 43. min. 55. seco.

And the meane motion, betweene both these motions, next aboue in 24 houres, is 50. min. 3. seconds. 30. thirds.

Which motion is iustified twise, as aboue: therfore I conclude the meane departure, of the Sunne and Moone in 24. houres to be 50. min. 3. seconds 30. thirds.

And the hourely departure, accordingly to be 2. min. 5. secon. 8. thirds 45. fourths.

Stadius affirmeth in his Ephimerides, that in 24. houres the whole equator and 59. minutes. 8. seconds is turned about, which is moste certaine.

Likewise in a meane hee affirmeth that the conjunction of the Sunne and Moone in one period, at any one time in the years, shall differ from the same time the next yeare, and bee sooner 10. dales, 21. houres 11. min. as for example:

In the 12. meane sinodical monthes, the time that wanteth of 12. times 30. dales, is 5. dales, 15. houres 2. minutes, which maketh 360. dales, the remainder of the dales of the whole years is 5. dales, 6. houres, 9. minutes, which both together is 10. dales 21. houres 11. min.

Now for the refining of the first 2. parts, let these last two parts following suffice, concerning their error in reckoning their tides, delivering the time by the points of the Compasse: for the confuting heereof, I will deliver 6. examples, three examples in the north latitude 30. degr. and the other 3. examples in the north latitude 51. degrees 32 minutes.

North latitude 30. degrees, the Sunne in Capricorne

1. The Sun at south east, it is then ¼ before 9. a clocke in the morning.

morning, but if the Moone hath 5. degrees south latitude, then it is 24. minutes before 9. a clock: if the Moone haue 5. deg. north latitude, then it is 16. min. past 9. a clocke.

Sunne in the equator.

The Sunne at Southeast, it is then 14. min. past 10. a clocke in the morning: but if the Moone haue 5. degrees south latitude, then it is 1. min. before 10. if the Moone haue 5. degrees north latitude: then it is 30. minutes past 10. a clocke.

Sunne in Cancer.

The Sunne at southeast, it is then 32. min. past a 11. a clock in the morning, but if the Moone hath 5. degr. south latitude, then it is 15. minu. past a 11. if the Moone hath 5. degr. north latitude, then it is 54. minutes. past a 11. of the clocke.

And at an east Sunne, it is then 18. min past 9. a clocke in the morning, but if the Moone haue 5. degrees South latitude, then it is 24. min. past 8. a clocke: if the Moone haue 5. degr. north latitude, then it is 40. min. past 10. a clocke. So that in this north latitude of 30. degrees, there is difference of time in the Moones being southeast, 3. houres, 18. min. and in the same latitude, difference from 6. a clocke in the east 4. houres 40. min.

The other 3. examples in the north latitude 51. deg. 32. min.
the Sunne in Capricornus.

1. The Sunne at the southeast, it is then 20. minu. before 9. a clocke in the morning: but if the Moone hath 5. degrees south latitude, then it is 28. minutes past 8. if the Moone haue 5. degr. north latitude, then it is 51. min. past 8. a clocke.

Sunne in the equator.

The Sunne at the southeast, it is then 28. min. past 9. a clocke in the morning: but if the Moone haue 5. degrees south latitude, then it is 18. min. past 9: if the moone haue 5, degr. north latitude then it is 38. min. past. 9. a clocke.

Sunne in Cancer.

The Sunne at the southeast, it is then 18. min. past. 10. a clocke

in the morning: but if the Moone hath 5. degrees, south latitude, then it is 6. minut. past 10. If the Moone haue 5. degrees north latitude, then it is 30. min. past 10. a clocke.

But at an east Sunne, it is then 22. min. past 7. a clocke in the morning, but if the Moone haue 5. degrees south latitude, then it is 2. minutes past 7. If the moone haue 5. degrees north latitude: then it is 42. minutes past seauen a clocke: likewise in this north latitude 51. degrees 32. minutes, there is difference of time, in the moone being south east, 2. houres, 2. minutes.

And in this same latitude, difference in the east from 6. a clock 1. houre 42. minutes: the mistaking of thus much time, from a hie water, may ouerthrowe their charge in going into a harbor, where it is to be respected.

2. And whereas they deliuer in their Tide Tables, a hoying of the tide in cõiunction aspect or opposition to 48. mi. after the order in that tide Table, it is not so, but in a riuer or indraste, where the Tides in their prime runneth quicke, there tides of flouds will runne, 48. minutes after high water, and thus will I leaue the delating of the tides.

Concerning the Time.

SUch is the conceite or knowledge of moste Sea-men in these times, they take a common compasse, little respecting the error thereof, being touched with a stone of no strength, and made wise by a man of no knowledge: which Compasse they deuide into 24. houres, to deliuer vnto them, (they obseruing the Sunne therewith) the time they looke for, which is as leaue a deliuerie of the times as may be, and is somewhat touched before, in the deliuerie of the Tides, and likewise as hereafter followeth.

Also they obserue the time by an houre, or halfe houre glasse, made by as carefull a man, as the Compasse before spoken of, who indeede careth but little what error more or lesse, is deliuered by these glasses in 24. houres, nay in halfe an houre, with in borne (as the prouerbe is) an inch breaketh no square.

Which Compasses and glasses had neede to bee carefully respected.

spected, nay rather to bee reformed, for the securitie (as aforesaid) of the Nauie of England, which is greatlye indaungered by them: and although these appendances for nauigation be meere false, yet the Market-folkes being not experienced by them, in consideration of the cheapenes of them, holding themselues therby, profitable seruants to the owner.

And [although the time generally from one noone to the other, cannot bee perfectlye deliuered by any man, as heereafter shall bee shewed: yet by precise instruments carefullye made, the time may bee deliuered more truelye which is the greatest helpe wee haue in longitude & for a man most careful, making of his compasses, and running glasses, I commend Maister *Emerie Mollinax* of Lambeth, (while he liued) and as for my consaite, which I haue learned concerning the time, it is as heereafter followeth.

First for the confuting of the time deliuered by the compas, as aforesaid, which Compasse is deuided by 360. degrees, which in deede are Azimuthes, and they iustifie as manye Azimuthes, which is 15. for one houre, as for an other which is contrarie, therefore I will deliuer three examples to that effect in the latitude 51. degrees, 32. minutes as followeth.

Sunne in Capricornus.

From the Sunne rising to one houre of time, there is 12. Azimuthes, and a ½ & from a 11. a clock to 12. at noone there is 14. Azimuthes.

Sunne in the equator.

From the Sunne rise, to one houre of time, there is 12. Azimuthes, and from a 11. a clocke, to 12. at noone, there is 18. azimuthes and ½.

Sunne in Cancer.

From the Sunne rise to one houre of time, there is a 11. Azimuthes and ½. and from a 11. a clocke to 12. at noone, there is 28. azimuthes.

Also followeth 2. examples: the one in the north latitude 51. degrees, 32. minutes: the other in the north latitude, 66. degrees, concerning the difference of time, as followeth.

The 1. example in Latitude 51. degr. 32. min.

Aries whole signe, hath declination 11. degrees 20. min. which reacheth in longitude Eastward, according to the degrees on the equator to the 28. meridian, likewise this hole signe of Aries doth length the daies, 1. houre and 58. min.

Taurus, his whole signe, hath declination 8. degrees 50. min. which reacheth in longitude eastward according to the degrees on the equator, to the 29. and a halfe Meridian: also this whole signe of Taurus doth length the daies one houre and 44. minutes.

Gemini, his whole signe, hath declination 3. degr. 18. min. which reacheth in longitude eastward, according to the degrees on the equator to the 32. and a halfe Meridian, also this whole signe of Gemini doth length the daies 1. houre 40. minutes.

The 2. example in north latitude 66. degr.

Aries whole signe, length the dayes. ---3. hour. 6. 46. min.
Taurus whole signe, length the daies. ---3. hour. 6. 38 min.
Gemini his whole signe, length the daies, ---3 hour. 6. 0. min.

But seeing that the generall time, from one noone to another, cannot be delivered certaine, but there shall bee error, so that one 24. houres shall be longer, or shorter then another by one houre & 28. min. as hereafter shall be delivered: what certaine time then can be delivered by any instruments so that purpose, which delivereth but a second error.

Now will I deliver some causes, why the time from one noone to another cannot be of like time.

Meſline in his Astronomy delivereth that there is three ecliptickes as followeth:

First the ecliptick of the 10. Spheare which is fixed.

Second the ecliptick of the 9. Spheare which is moveable.

Thirdly the ecliptick of the 8. Spheare which is the true ecliptick of the starry firmament.

Likewise he delivereth that ☉ Sun in Aries of the 9. Spheare is gon to the Eastward of ☉ Sun in Aries of the 10. Spheare, 27. degrees and better, but directly under it, in the same plaine.

Also that the Sun in Aries of the 8. Spheare, never is nearer to the

the Sunne in Aries of the 9. Sphere, then by the semidiameter of the small circle, which is 9. degrees.

Note Mesline delivereth the difference of the judgements of the Astronomers, and that Ptolomie maketh the 8. & 9. Spheare all one, delivering the opinion of Ptolomies others, as followeth.

The opinion of Ptolomie concerning the motions of the fixed starrs, comparing the observations made 400. yeares before him, with his owne he finding thereby that the fixed Starres had mued in consequence 4. deg. therfore Ptolomie alowed to the whole revolution of the fixed starrs, to accomplish one period, according to ỹ rate that 36000 yeres, that was for every 100. yeres one deg.

Mesline delivereth also that the opinion of the *Alfonsines*, concerning one revolution, or accomplishing of one period of the 9. Spheare is in 49000. yeares, but according to Copernicus his observations, one periodicall revolution is in 25816. yeares, delivering that an houre of the longest day is 63. minu. 40. seconds, such as an houre of the shortest day is onely 60. min.

Copernicus maketh (likewise) the yeare 365. daies, 5. houres, 49 min. 15. seconds, 46. thirds, which he calleth the yeare ♈ Tropicall, equally supputated, or counted to the middle equinoctiall.

The *Alfonsines* in their account, wanteth in their yearely period. 13. thirds.

Mesline maketh the yeare 365. daies, 6. houres, 9. minutes, 39. seconds, and this yeare he calleth Siderial or Starrie, numbred under the 8. Spheare of the fixed starres, which is more then the yeare delivered by Copernicus by 20. min. 23. seconds, 14. thirds.

Delivering the causes of this difference to be this, making these beginning of the yeares to be in one point of the 10. & 9. spheares & the 9. spheare (before the yeare ende) being removed easterly from the 10. Spheare, the yeare ende comming to that point of the 12. Spheare againe, is to proceede from it to that point of the 9. spheare, also before the yeare endeth.

Mesline delivereth (the Sunne being in the Apogæum parte) that from midle motion to middle motion, ỹ sun passeth 176. deg. 20. min. of the ecliptick: And the sun being in the Perigeum parte, from midle motion to middle motion, passeth 183. degrees 40. minutes of the ecliptick, which maketh a differences of 7. degr. 20. minutes.

But from the points of true motions, the halfes are equall, each 180. deg. of the ecliptick: and the arke of time betweene the middle & middle motion of the Sunne in apogæum parte, is 182. daies and 6. houres.

Also the arcke betw. the true motion, and true motion of the Sun in the perigeum parte, is 179. daies, which maketh the arche of time betweene the middle & the middle motion of the Sunne in apogæum, from thence in perigeum, by three daies and 6. houres.

Also maketh the arcke of time, betweene the middle & true motion of the Sun in both the meane motions, to bee 4. daies, and the arcke of time differeth from the true motion, to the true motion of the Sunne in apogæum, from the same points in his perigeum, to be 7. daies and 8. houres.

And as for the rule of the Theorike of the Sunne and moone, I haue deliuered sufficient in my deliuerie before, concerning the tides.

But to conclude, Stadius in his Ephemerides, folio 57. of the Equation of the naturall daies, deliuereth as followeth concerning the time.

Wee haue computed all the places of all the planets, and also of the Sunne and Moone in this our Ephemerides, for the naturall daies (to witte,) for that space, in the which the whole equator is turned about, and wanteth 3. minutes and 8. secondes: but because the apparent, and true day now and then doth exceede this time, and now and then is lesse: to wit,

Partly when as the Sunne goeth swifter, or slower by reason of his prosthopheresis.

Partly for that equall times of the equator, in the diurnall exaltation, or revolution thereof, doe not answere in equall sagments, or partes of the Zodiacke, it commeth to passe, that this inequalitie of time also needeth a prosthopheresis, the which notwithstanding, cannot be alwaies equall nor certaine.

For the connection of the Circle of the Equator, though vnto the middle and equall equinoctium, which is the peare deuided into foure equall parts, is euermore equallye constant, yet neuer

uertheleſſe, vnto the apparant equinoctium which are the true equinoctiis which the excentricke yeelds, is found not equall.

Neither dooth the ſunnes apogeum, occupie a ſtable ſeate, becauſe the apogeum fleeteth in the eclipticke euerie 13 yeares 1. degree 27. minutes: moreouer the ſunne in his excentricitie doth ſome hurt by his ſhifting, for the excentricitie is more & leſſe by a 11. ſemidiameters of the earth, as afore ſaide, and goeth about with the eclipticke.

Wherefore alſo no limite can bee appointed perpetuallye to this inequalitie, but in this our age, all theſe cauſes conferred one with an other, and added together, doe ſhowe that the greateſt day and leſſe day doe differ one from an other, one houre and 28. minutes, that is to ſay 22. times, (or Meridians,) and 30. minutes of the equator.

But ſeeing that this inequallitie of daies cannot miſſeuer the reſt of the motions, therefore it is neceſſarye that wee ſhould admit them to bee equall, vnto the which equall dayes, the Tables of the motions ſhould bee both made and ſet together, the which courſe wee haue taken in this our Ephimerides, and for that cauſe wee haue borowed the canon of equation of daies out of Erafmus Rheinholdus which agreeth neareſt with our age, vntil the yeare 1600.

Therefore according as you finde the number in that cannan to adde or ſubſtract: that is the time that the day is either longer or ſhorter, then the equall day, or the day of the Ephimerides, that is the firſt equated day, or day equated vpon the difference of 22. minutes, whereas the ſecond equation is of dayes once equated, and if we both equate them vpon the difference of 44. minutes, whoſe halfe is 22. minutes, the greateſt number within the canon.

Seeing there is a firſt error concerning the time deliuered, euen in the motions of the heauens, as afore ſaid: therefore theſe running Glaſſes delinering but a ſecond error: the reaſon is this: becauſe that they cannot

be made without their imperfections, had neede to be moſt carefully made, and by the preciſeſt workman: that the time deliuered by them, may be but accoꝛding to the ſecond erroꝛ, foꝛ the deliuerie of the longitude, by which running glaſſes, next hereafter nominated, the longitude is better deliuered then by any other inſtruments.

A glaſſe whoſe ſand is mettal, and the mettal ſaid by ſome, will not ruſt, notwithſtanding in my opinion will ruſt ſomewhat, and bee ſometimes moyſter, then at other times, likewiſe the hole that the ſand runneth thꝛough, will growe wider with the foꝛce of the ſand, the rather being violated by the ſurges of the ſea: which imperfections conſidered, the glaſſe muſt needes deliuer the time, ſometime ſhoꝛter, & ſometime longer, accoꝛding to the weather, therefoꝛe a ſecond erroꝛ: yet this glaſſe is moꝛe tollerable then the reſt foꝛ this deliuerie, and is to bee uſed befoꝛe all other, of which glaſſes there may bee diuers ſoꝛtes, foꝛ the deliuerie of moꝛe and leſſe time at pleaſure.

And becauſe the running glaſſes with ſand is moꝛe groſſer, and that clockes and watches hath their moꝛe imperfections, then the foꝛmer glaſſe, I will omit them, and leaue the deliuerie of the time foꝛ this preſent.

Concerning the winds according to experience.

Differences oꝛ diuerſities of windes, I haue ſeene at ſea, in ſome calme day (in Summer time) among diuers ſhipping, being of one ſtate, ſo that ſome ſixe of them oꝛ moꝛe, haue all had contrarie windes till the winde was ſetled.

Likewiſe in ſummer time I haue knowne in places of ſmall diſtance, as at Hābrough, the winde at weſt ſouth weſt, ſo much winde, that wee haue rid with our top-maſt downe, and at Lee the verie ſame time, the Ships then bound foꝛ Hambrough, had as much winde (by repoꝛte) at eaſt noꝛth eaſt, but both theſe windes continued not long, and betweene which windes no doubt it was calme foꝛ the time.

Alſo in winter time, I haue ſeene it often in being at ſea, the winde being at ſouth, ſouth eaſt, much winde, and upon a ſudden the winde hath altered to the noꝛth weſt, oꝛ noꝛth noꝛth weſt, verie much winde, and ſo alterations of windes, I haue likewiſe

ſeene

seene vppon other pointes of the Compasse.

And in sayling toward Head lands, or in sayling about Head-lands I haue found the winde sometime to large vnto vs, and other times againe to scant vnto vs: Therefore the winde verie difficulte to relate vppon, my farther reason is this because it is deliuered in the Scriptures that the winde bloweth, but from whence it commeth or whether it goeth no man knoweth.

Yet notwithstanding, many times in Summer time, but especially in winter time, when growen stormie windes are settled, wee may coniecture that they extend farre, and in my opinion (which opinion I holde for truth) the winde then bloweth in a great circle, therfore cannot be paralel, to any great circle of that nature, my reason is this, because great circles doth crosse themselues at oppolite pointes, as in the demonstrature of the compasse is deliuered.

Therefore this deliuerie confuteth the flat Cards, my reason is this, because the flat cardes deliuereth the windes to blow in paralels, according to the lineaments thereof.

Likewise by the Carde, the winde at east, and a Ship going west, eyther in the latitude 33. degrees, 35. minutes, and latitude 80. degrees, or in the north latitude 80. degr. 15. minu, or in what latitude elle soeuer, it is said to leave in a paralel, notwithstanding, the Carde deliuereth the going west to make right angles with the meridians which is verie absurde, and that the winde continuing, they shall goo west still afore the winde.

Concerning the winde by Sphericall working.

The 1. Example.

PResuppose a first place (which I will call our place of departure) in any one degree of longitude what soeuer, and in the north latitude of 33. degrees, 35. minutes, in which place the east and west of the Compasse, according to the demonstrature, is a tangent vnto this paralel, and crolleth the equator at oppolite pointes 90. degrees in longitude eastward and westward, which east and west pointes in the Equinoctiall keepe in minde.

I purpose from this first place (as afore said) to sayle to a second place according to the way of the west vpon the difference which shall bee in longitude from the first place 90. degrees, which 90.

90. degrees, in these paralels is 75. degrees of a great circle little more: now in this second place which is at this present, my place of beeing, I finde my selfe elated from the paralell according to the difference, where I purpose to deliver the east and west (likewise) according to the demonstrature, being also a tangent, unto this paralel, and crosseth the equator at opposite pointes according to the former, but 90. degrees different in longitude, which two demonstrated semicircles doe crosse each other in 24. degrees, 15. minutes of latitude 46. degrees in longitude from the first place, and 44. degrees in longitude from the second place.

Now from my first place of departure, the second place doth beare according to the demonstrature of the Compasse, west, north west, and 5. degrees, northerlye, uppon which point the two places are distant 73. degrees 15. minutes of a great circle, which is a nearer way then the way uppon the west according to the difference as afore said, by 1. degrees 45. minutes.

And from my second place of beeing, the first place of departure, doth beare according to the demonstrature of the Compasse, east north east, and 7. degrees northerlye, upon which point likewise the two places are distant 73. degrees 15. minutes.

So by this deliverie having continued the ships saying as course west from the first place of departure to the second place, I doe conclude that the winde beeing constant and stable in blowing from the first place to the second place, that at the second place the winde is altered 2 full two pointes and 7. degrees to the north ward, as aforesaid, though it were at east in the first place, which delivery in my judgement is the truth.

But if the winde, beeing at the first place bee at east, and in saylinge to the second place bee variable and alterable, as the east and west by the demonstrature is variable in crossing the equator according to the difference in longitude, then you shall goe from the first place to the second place west as afore said (the winde beeing at east) right afore the winde, but this waye in my judgement is impossible and not the truth.

A second

A second example.

Being in 60. degrees north latitude and in one Meridian of longitude, which is my first place, which hath his demonstrature of east and west accordingly, beeing a tangent vnto this paralell, and in crossing the equator at opposite pointes, after the manner in the first example, from whence I sayle west accordingly to the difference to 90. degrees in longitude, which 90. degrees in longitude in these paralels is 45. degrees of a great circle, little more, which is my second place: in which second place I finde my selfe there to bee dilated from the paralell according to the difference, and in which second place, likewise I purpose to deliuer the east and west according to the former, but 90. degrees different in longitude, and these two demonstrated semicircles, doe crosse each other in 50. degrees of latitude 46. degrees 20. minutes in longitude from the first place, and 43. degrees, 40. minutes in longitude from the second place.

So that from my first place of departure, the second place doth beare (according to the demonstrature of the Compasse) north west and by west 5. degrees 20. minutes northerly, vpon which point the two places are distant 42. degrees, 35. minutes of a great circle, which is likewise a neerer way, then the way of the west according to the difference, as a forsaid, 2. degr, 35. minutes.

And from the second place of being, the first place of departure, doth beare according to the demonstrature of the compasse, northeast and by east, and 8. degrees 20. minutes northerly, vpon which point the two places are also distant 42. degrees, 35. minutes of a great circle.

So that by this deliuerie being at this second place, the winde is altered of mee three pointes, and 8. degrees 20. minutes northward, though it were at the east in the first place.

The 3. example.

Being in 80. degrees 15. minutes north latitude, and in one meridian of longitude, which is my first place, which hath his demonstrature of east and west accordingly, being a tangent vnto this paralel, and in crossing the equator at opposite pointes, after the maner in the first example, from whence I sayle west according to the difference to 90. degr. in longitude, which 90. degrees in longitude in these paralels, is 15. degrees of a great circle, little more, which is my second place: in which second place I finde my selfe there to bee delated from the paralell, according to the difference.

And in which second place, I purpose to deliuer also the east and west, according to the demonstrature, which likewise crosseth the equator at opposite pointes, according to the former, but 90, degrees difference in longitude, and these two demonstrated, semi-circles doe crosse each other in 75. degrees, 45 minu. in latitude, 48. degrees in longitude from the first place, and 42. degrees in longitude from the second place.

So that from my first place of departure, the second place doth beare according to the demõstrature of the compasse north west and by west, and 8. degrees northerly: vpon which point the two places are distant 14. degrees of a great circle, which also is an nearer way then by the west as aforesaid by one degree.

And from my second place of beeing, the first place of departure doth beare according to the demonstrature of the Compasse northeast, one degree 20, minutes northerlie, vpon which point the two places are distant 14. degrees of a great circle.

So that by this deliuerie being at the second place, the winde is altered of me 4. points and one degree, 20. minuts to the northward, though it were at east in the first place.

A thing worth the noting.

In all the three examples, as aforesaid, this thing worthie the noting might be deliuered, yet I will deliuer but one of them, according to the second example in latitude 60. degrees: in which second example or deliuerye, the intersection or crossing of these two

two semicircles of east and west, according to the demonstrature from the first place of departure and second place, is in latitude 50. degrees, which intersection is from the first place west, & from the second place east.

Yet being in this intersection, the first place beareth from it north east by east, and 5. degrees, 38. minutes northerly, and distant 27. degrees 32. minutes of this great circle.

And the second place beareth from it northwest and by west, 1. degree 40. minutes northerly, and distant 26 degrees, 20. min. of this great circle, according to the demonstrature of the compasse: and thus much concerning the winde.

Concerning the way of a ship or shipping at sea.

First there is to be understood and likewise to bee respected by him that hath the charge (whatsoever in navigation,) that there is two lawfull & good navigable courses to bee vsed at the seas, and no more, eyther of which courses is verie artificiall (the keeping of them aright) and resteth in the good discretion of the said Maister, being likewise artificiall, which of them hee will vse.

But if the said Maister be not artificiall, and a man of great conceite, the manner or way of these courses bee to deepe for his understanding, and therefore hee not worthie to take charge at all.

My reason is this, because all other courses whatsoever more then these two, are absurde, friuolous and false: the names of which two courses followeth.

First the course vpon the great circle being the neerest way from place to place.

The first course is to sayle vppon a great circle which is after this manner: being in any one latitude and longitude whatsoever, which is your first place, and doe purpose to sayle from thence vppon any azimuthes of demonstrature whatsoever, which are great circles, vntill you come to 90. degrees in longitude, which is vnto the Horizon of your first place, in which way you are to respect euerie day at noone your latitude, (if you may) and likewise your time as before, or hereafter shall be deliuered for the [illegible]ie of your longitude, you are likewise to respect your [illegible]

mants, being of whatlength soeuer vpon the Azimuthes you sayle, how you are, (vpon any distance) to crosse the meridians and paralels: for if you finde your selfe in such a latitude, as you should bee in, and not in the right longitude, which the Azimuthes you should sayle vpon giueth, then are you also wide & to seeke reformation: also if you finde your selfe in such a longitude and not in the right latitude, which your Azimuthes giueth, then are you also wide & to seeke reformation, therfore being a harder way or course to sayle vppon the great circle, (notwithstanding this way the neareſt way, or course from place to place of all other wayes) requiring alwaies reformation with great iudgement, I will onely deliuer 6. examples from one meridian of longitude and latitude 51. degrees 32. minutes vpon the demonſtrature, north west and by north, continuing it from the first place to the Horizon by fragments of 15. degrees of a great Circle a peece, only for a taſte and your farther knowledge of this way, and so will leaue it, and heareafter will deliuer the remainder of the second course or way, which is more easie according to the difference, being the onely and naturall way indeede that the Compaſſe leadeth in.

The 1. Example.

Being in the latitude and longitude, as aforesaid, 15. degrees of a great circle from thence, according to the demonſtrature of north west and by north, crosseth the 18. degrees 30. minutes, or meridian in longitude westward from the first, and the paralell of north latitude 62. degrees 50. minutes,

The 2. Example.

Other 15. degrees which maketh 30. degr. from the first according to the demonſtrature of north west & by north, toucheth the meridian of 50. degr. in longitude west-ward from the first, and the paralel of north latitude 69. deg. 28. min.

The 3. example.

Other 15. degrees which maketh 45. degr. from the first, according to the demonſtrature, of north west and by north, toucheth the meridian of 92. deg. 50. minutes in longitude west ward from the first, and the paralel of north latitude 66. degrees 45. minutes.

The 4. Example.

Other 15. degrees which maketh 60. degrees from the firſt, accoꝛding to the demonſtrature of noꝛth weſt and by noꝛth, toucheth the Meridian of 118. degrees, in longitude weſtward from the firſt, and the paralell of noꝛth latitude 57. degrees.

The 5. Example.

Other 15. degrees which maketh 75. degrees from the firſt, accoꝛding to the demonſtrature of noꝛth weſt and by noꝛth, toucheth the meridian of 130. degrees 32. minutes in longitude weſtward from the firſt, and the paralel of noꝛth latitude 44. degrees 35. minutes.

The 6. Example.

The other oꝛ laſt 15. degrees, which maketh 90. degrees from the firſt, and is the Poꝛiſon thereof, accoꝛding to the demonſtrature of the noꝛth weſt and by noꝛth, toucheth the Meridian of 139. degrees, 15. minutes in longitude weſtward from the firſt, and the paralel of noꝛth latitude 31. degrees 10. minutes.

And as foꝛ the ſecond courſe oꝛ way of the Compaſſe vppon the difference which we will relye vpon, I haue deliuered ſufficiente ſpe thereof, as aboꝛe ſaid, and foꝛ that which is alſo needefull beſides concerning this way vpon the difference to bee delinered, heareafter in good ſoꝛte, and oꝛder followeth.

There is to bee reſpected by a Maiſter of a Ship, oꝛ the man that taketh charge in nauigation, the goodneſſe of the compaſſe which he layeth by, with the nutation thereof in any place if it be needefull, otherwiſe it will cauſe the way of a Ship to bee in an Azimuthe contrarie to his erpectation, which will cauſe an erroꝛ.

And foꝛ the vnderſtanding of this nutation what it is, in any place may bee deliuered by a man of good conceite, as followeth, hauing a Topographical inſtrument, oꝛ otherwiſe called a Theodolite of braſſe, perfective made, and the needle good, beeing well touched with an excellent ſtone, and handled foꝛ the purpoſe, deliuereth the nutation verye wel: but if the ſea-gate be ſo great ỹ this inſtrument cannot deliuer it certaine, ỹe will no inſtrumit (let foꝛth foꝛ this purpoſe) deliuer it n. ỹther, then

then must you worke thus, the height of the Sunne in the meridian at noone obserued by the Compasse, the Compasse it selfe, then deliuereth the nutation from noon, but rather thus: the latitude at noone knowne, then vpon any obseruation of the Sunne by the compasse on any elevation about 3. a clocke in the afternoone, the declination respected, the Compasse deliuereth the nutation more truer, my reason is this: because the decention of the Sun in his diurnall Arche at this time in the afternoone, is more swifter towards the Horizon, then it is, the Sunne beeing neere the Meridian.

Also that the said Master haue with him al the best running Glasses that can bee made, as is fore said, to deliuer the time vnto him, as certaine as may be, which must be regarded as a principall thing, the coarting of the meridians respected, for the deliuerie of the longitude in any place, by which way the longitude is deliuered after the best manner, the latitude being knowne, otherwise, the time not respected or regarded, the longitude will bee deliuered with the more error.

Likewise the Azimuthe of the way must bee deliuered or set downe according to the difference, and not otherwise, and not aboue 20. leagues the Segmentes for the shorter the Segmentes bee, the truer the reckoning, which Azimuthes of way vpon the like, rence, deliuereth the longitude also in reasonable sorte the latitude beeing knowne, yet in this way is more obscuritie, then in the former way for the deliuerie of the longitude.

Moreouer there is to be respected by him that hath the charge in naulgation, the violence of windes, sea-gates, tide-gates, currents, Eddies or whatsoeuer elle, that may eyther be helping of the ship in her way, or a hinderance of her way, which causeth an Azimuthe of way, contrarie to expectation, which not regarded, bringeth also a error.

And for the obseruing of latitudes at the seas, it had needs to be verie precisely done, hauing a large quadrant of brasse with a mooueable perpendiculer accordingly, deliuereth it in the best sorte: for in obseruing with crosse staues there is error, my reason is this, the staffe not fully protected to the greate circle, deliuereth error: my further reason also is this in obseruing with the staffe, the eye is fayne to beholde 2 notes two thinges at once,

which

which is the center of the Sunne, and the Horizon, which is not possible to be done truely.

And in a Sea-gate it can neither be precisely delivered by an astrolabe, therefore the quadrant best for this purpose, for in obseruing therewith, there is but onely the center of the Sunne, to be respected.

Also there must bee great care had by him that hath the charge in nauigation, unto the steridge of the ship, that it be greately respected of him, and of those principall men which goeth in the ship with him, which hee doth appoint for this purpose, because the man at the steridge may bee negligent, and by some men that may be at the steridge, as I haue seene my self ere now, a three or foure pointes of eyther side of the course, commaunded to bee kept, breaketh no square with him, which had or contrarie steridge to expectation, not counted of or note, breedeth a foule error.

And whereas there are infinite sorts of Shipping, for bignes, length, and draft, so they are as different in qualities, wherefore I will deliuer as many qualities concerning all sortes of Shipping, as at this present I can remember, leauing the consideration of the rest, (not now remembred by mee, unto him that hath the charge for the present) with those nominated, according as hee shall finde the Shippes qualitie to bee which hee goeth in, the qualities as followeth.

Of Shipping there are diuers sortes, which haue diuers qualities, the reason is this, because they are different in bignes and [illegible], [illegible]. To proceede, some of them are long, & some short, some of them flottie, and other some of great charge or draft, some haue a desire or cast to portwarde, and some other to starbord, some of them good to sayle (trye) weather about without [illegible], and other some qualified to the contrarie, some are desirous to haue there stayes, and shrowdes slacked, and some to haue them [illegible], some Ships desire to be trimmed a head, some [illegible], and some others of an euen keele, some stereth hard euerie way, & other some easie of stereidge any way: some Ships [illegible] in a [illegible] gate will stay, or wend to windward, and other some cannot, but must [illegible] the winde, which is a great [illegible] long and shorte shipping being flotty, are [illegible]

in a sea-gate, but long or short going deepe Shipping, is easie at sea some are fast Ships uppon a winde, and some others are lee-warde, some are good shippes of a sayle quarter windes, and some not so good: some are good a fore the winde, and some others to the contrarie, some Ships are stiffe sided: which is a principall qualitie, and some other are tender sided, which is a bad qualitie, some Ships are of advantage in their weyght, and other some are to the contrarie.

Therefore the qualitie of a Ship is greatlye to be regarded of him that hath the charge, for a Ship of advantage or disadvantage, causeth an Azimuthe of way contrarie to expectation, which not being respected causeth an error.

Now for your Iournal by some called a Reuners booke, or book wherein you keepe reckoning of the Ships way at the Seas, in my conceite, and as I doe use, is in manner as followeth.

In the head or beginning of which booke, set downe the title thereof, with the month, day, and date of our Lorde, at the time of your beginning to enter into your navigation after which being set downe, devide the leaves [illegible] into 10. spaces or columns and set downe in everie column as followeth.

In the 1. column of which Booke, set downe the monthes and daies, according to the sequell of them, as the time spendeth.

In the 2. column set downe the houres of time spent in sayling upon the Azimuthes used.

In the 3. column set downe the Azimuth of the winde, or that the winde for the time was in.

In the 4. column set downe the course which you have kept, that is the course on the true Azimuth, according to the difference.

In the 5. column set downe the quantitie of leagues runne upon the Azimuth by judgement of length as aforesaid.

In the 6. column set downe the degrees of the pole elevated.

In the 7. column also the minutes if there be any of the pole elevated.

In the 8. column set downe the degrees of longitude reckoned by the time and latitude as aforesaid.

In the 9. column also the minutes (if there be any) of the longitude

gitude so delivered.

In the 10. collume set downe your discourse of things, according as you finde occasion.

And to conclude.

Querie of which inconveniences, or rather good knowledge, and understanding as aforesaid being thus noted, knowne and regarded by him that hath the charge, hee shall deliver in his navigations the shipps way he goeth in with all advantages, who is worthie to be trusted with any charge, and to receave great commendations.

But to the contrarie, hee that hath the charge, not respecting these thinges, as aforesaid, hee delivereth the shipps way with all absurdities and error, and to speake the truth, he is not worthie to take charge at all, but to have an inferior place, which he is more fitter for: and thus will I leave dilating

 of the way of shipping at Sea.

FINIS.